

Bulletin de l'Académie Royale de Belgique, May.—On the new elements of the orbit of Eucharis, by L. de Ball. Continuing his researches on the elements of this planet (181), the author here establishes two new normal positions by means of the observations made in 1886 and 1887. He also revises the positions of the comparison stars, and resumes the calculation of the perturbations caused by Jupiter, Saturn, and Mars, utilizing for the last named the results of Asaph Hall's observations on the satellites.—Contribution to the study of pulsation in the lower animal organisms, by Dr. De Bruyne. The results are given of the author's studies on the pulsating function of an encysted Protozoön obtained in abundance by culture, but of not yet determined family. From his minute observations on the formation, development, and action of the vesicle endowed with rhythmical motion, he concludes that this organ has no communication with the periphery, and has nothing to do with the digestive function, as is commonly supposed, but is a true organ of respiration and circulation, a heart and lung combined.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—“The Conditions of the Evolution of Gases from Homogeneous Liquids.” By V. H. Veley, M.A., University College, Oxford.

In Part I. an account is given of the effect of finely divided particles on the rate of evolution of gases resulting from chemical changes; in Part II. the phenomenon of initial acceleration, as also the effect of variation of pressure on the evolution of gases, is discussed; in Part III. the case of the decomposition of formic acid into carbonic oxide and water is investigated under constant conditions, other than those of the mass of reacting substances and of temperature.

Part I.—It is found that the addition of finely divided chemically inert particles increases the rate of evolution of gases from liquids in which they are being formed. The effect of these particles on the following chemical changes is investigated: (i.) the decomposition of formic acid yielding carbonic oxide; (ii.) the decomposition of ammonium nitrite in aqueous solution yielding nitrogen; (iii.) the reduction of nitric acid into nitric oxide by means of ferrous sulphate; (iv.) the decomposition of ammonium nitrate in a state of fusion producing nitrous oxide; and (v.) the decomposition of potassium chlorate in a state of fusion producing oxygen. The finely divided substances used are pumice, silica, graphite, precipitated barium sulphate and glass-dust.

Part II.—It is observed that, conditions of temperature remaining the same, the rate of evolution of a gas from a liquid is at first slow, then gradually increases until it reaches a maximum, and for some time constant, rate. From this point the rate decreases proportionally to the diminution of mass. This is observed in the cases of decomposition of formic acid, potassium ferrocyanide, and of oxalic acid by concentrated sulphuric acid, and in that of ammonium nitrate. It has previously been observed in the case of the decomposition of ammonium nitrite in aqueous solution. The same phenomenon repeats itself when the temperature is temporarily lowered and then raised to its former point, and also to a more marked degree when, temperature remaining the same, the superincumbent pressure is suddenly increased.

The reduction of pressure from one to a fraction of an atmosphere produces no permanent effect on the rate of evolution of a gas from a liquid; a decrease of pressure, however, produces temporarily an increase in the rate, and an increase of pressure conversely produces temporarily a decrease in the rate.

Part III.—The case of the decomposition of formic acid into carbonic oxide and water by diluted sulphuric acid is studied with the aid of an apparatus by means of which the temperature is kept constant within one-twentieth of a degree. It is shown that the rate of evolution of carbonic oxide is expressible by the following equation—

$$\log(\tau + t) + \log r = \log c,$$

in which τ is the time from the commencement of the observations; t is the interval of time from the moment of commencement, and that at which, conditions remaining the same, the interval of time required for unit change would have been nil ; r is the mass at the end of each observation, and c is a constant.

The results calculated by this hypothesis agree with those observed, whether the interval of time required for unit change is 30 or 960 minutes. The curve expressing the rate of chemical change in terms of mass is thus hyperbolic and illustrative of the law—

$$\frac{dr}{dt} = -\frac{r^2}{c},$$

which expresses the rate at which equivalent masses act upon one another; $1/c$ in each experiment is the amount of each unit mass which reacts with the other per unit of time, when a unit mass of each substance is present. Since, then, equivalent masses take part in the change, it is reasonable to suppose that at first an anhydride of formic acid is produced, which is subsequently decomposed into carbonic oxide and water.

The change may thus be compared to the production of ethyl formate from formic acid and alcohol, with which it shows several points of analogy.

June 14.—“The Electric Organ of the Skate. Structure and Development of the Electric Organ of *Raia radiata*.” By J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by Prof. J. Burdon Sanderson, F.R.S.

The first part of this paper is chiefly devoted to a comparison of the electric organs of *Raia radiata*, *Raia batis*, and *Raia circularis*. It is shown that the organ in the species *radiata* differs in many respects from the organ in the two other species, and that an exhaustive study of its structure and development is likely to throw considerable light on the nature of electric organs generally, and also on the structure of the motor plates of muscles. While *Raia batis* may reach a length of over 180 cm., *Raia radiata* seldom measures more than 45 cm. from tip to tip, and is thus only about half the size of a large *Raia circularis*. In *Raia radiata* the electric organ is absolutely and relatively extremely small. In *Raia batis* the electric organ may be 60 cm. in length and 7 cm. in circumference at the centre, and extend from the skin to the vertebral column, but in an adult *Raia radiata* the organ is seldom over 13 cm. in length and 8 mm. in circumference, and the posterior two-thirds is confined to a narrow cleft between the skin and the great lateral muscles of the tail. Further, the organ of *Raia radiata* consists of minute shallow cups, which only remotely resemble the large well formed electric cups of *Raia circularis*. In the latter species the various layers of the electric cup are readily comparable to the more important layers of the electric disk of *Raia batis*, but in *Raia radiata* the electric cup is little more than a muscular fibre, with one end expanded and slightly excavated to support a greatly enlarged motor plate, in which terminate numerous nerve-fibres. The striated layer of *Raia batis* and *circularis*, which consists of characteristic lamellæ, having an extremely complex arrangement, is entirely absent from *Raia radiata*, the electric layer is indistinct, and instead of a thick richly nucleated cortex, the cup is merely invested by a slightly thickened sarcolemma. Further, the tissue forming the shallow, thick-walled cup, both in its appearance and consistency, closely resembles an ordinary muscular fibre, while the long stem usually remains distinctly striated to its termination.

In the second part of the paper an account is given of the development of the electric cups of *Raia radiata*. It is shown that the rate of development compared with *Raia circularis*, but more especially with *Raia batis*, is extremely slow. The young *radiata* is nearly double the size of the *batis* embryo before the muscular fibres reach the “club” stage, and the long nearly uniform clubs, instead of at once developing into rudimentary cups as is the case in *batis*, assume the form of large Indian clubs. When the young skate reaches a length of about 35 cm., the long secondary clubs begin to expand anteriorly, and this expansion continues until a fairly well-moulded cup mounted on a long delicate stem is produced. But the process of conversion is scarcely completed when the skate has reached a length of 40 cm., i.e. when it has nearly reached its full size, for in the species *radiata* a length of 50 cm. is seldom if ever attained.

The cup-stage having been eventually reached, the stem, which for a time may still increase in length, is often compressed by two or more cups being closely applied together, and part of the rim of the cup may be slightly everted or projected forwards, but even in the largest specimens of *Raia radiata* examined there was never any indication of retrogressive changes.

The small size of the electric organ, together with the shallowness of the minute cups of which it consists, seems at first to indicate that in *Raia radiata* we have an electric organ in the

act of disappearing. But when the organ of the species *radiata* is carefully compared with the organ of the species *batis* and *circularis*, the evidence seems to point in an opposite direction, and the view that the cups of *Kaia radiata* are in process of being elaborated into more complex structures, such as already exist in *Kaia circularis*, is apparently confirmed by the developmental record. Were the electrical organ of *Kaia radiata* a mere vestige of a larger structure which formerly existed, we should expect to find the motor (electric) plate incomplete, or only occupying a portion of the electric cup; and the nerves proceeding to it, either few in number or undergoing degenerative changes. But instead of this we have a relatively large bunch of extremely well developed nerves proceeding to the motor plate, which is not only complete, but extends some distance over the rim of the cup. Further, there is no indication of the walls of the cup having ever consisted of extremely complex lamellæ, such as we have in *Kaia circularis*. They consist of a nearly solid mass of muscular tissue, scarcely to be distinguished from the unaltered adjacent muscular fibres. The electric cup of *Kaia radiata* may, in fact, when its structure alone is considered, be said to be a muscular fibre which has been enlarged at one end to support a greatly overgrown motor plate. But the development of the electric cups is even more suggestive than their structure. Had the muscular fibres in *Kaia radiata* assumed the form of clubs before the young skate escaped from the egg capsule; had the clubs been rapidly transformed into electric cups; and had the cups soon after reaching completion begun to disappear, the evidence in favour of degeneration would have been complete. But, as has been indicated, the conversion of the muscular fibres into an electric organ is late in beginning, and the clubs having appeared, pass slowly through a long series of intermediate stages before they eventually assume the cup form. Further, as has already been mentioned, in the largest specimens of *Kaia radiata* examined no evidence was found of retrogressive changes, either in the cup proper, or the numerous nerves passing to its electric plate. Hence it may be inferred that the electric organ of *Kaia radiata*, notwithstanding its apparent uselessness and its extremely small size, is in a state of progressive development.

EDINBURGH.

Royal Society, June 18.—In the report of this meeting the title of a paper on the development and life-histories of the food and other fishes, communicated by Prof. W. C. McIntosh and Mr. E. E. Prince, was inadvertently omitted.

July 2.—Prof. Chrystal, Vice-President, in the chair.—Dr. Ramsay Traquair read a paper on fossil fishes from the Pampherton oil-shale, and exhibited specimens.—Dr. W. Peddie read a paper on the effects of electromotive force and current-density on the total opposition (due to resistance of the conductors, reverse electromotive force, &c.) to the passage of an electric current through a liquid.—Mr. George Brook described a lucifer-like crustacean larva from the West Coast, and also communicated, in conjunction with Mr. W. E. Hoyle, a paper on the metamorphosis of the British *Euphrosiide*.—Prof. Haycraft and Dr. E. W. Carlier read a paper on morphological changes which take place in blood during coagulation.—Prof. Tait submitted a paper on Laplace's theory of the internal pressure in liquids.

July 9.—A special meeting was held, Sir Douglas MacLagan, Vice-President, in the chair.—Dr. Berry Hart read a paper on the mechanism of the separation of the placenta and membranes during labour.—Dr. Woodhead communicated a paper, by Dr. J. W. Martin, on the pathology of cystic ovary; and also a paper, by Mr. T. A. Helme, on histological observations on the muscle, fibre, and connective tissue of the uterus during pregnancy and the puerperium.—Dr. T. G. Nasmyth read a paper on the air in coal-mines.

PARIS.

Academy of Sciences, July 16.—M. Janssen, President, in the chair.—Experiments with a new hydraulic machine, by M. Anatole de Caligny. This apparatus is of less simple structure than the valved machine with oscillating tube already described and exhibited by the inventor. But it has the advantage, under certain conditions, of giving relatively better results.—On the planet Mars, by M. Perrotin. These remarks are made in connection with the four sketches referred to in a previous communication, which are here reproduced, and which give the appearance of the planet on May 8, 1888, June 12, 1888, May

21–22, 1886, and June 4, 1888. The two first show the new canal A and that of the north polar ice-cap, the second also giving the smaller canal B seen for the first time on June 12. The fourth shows four simple and three double canals, all clearly defined. Two of the latter stretch from near the equator along the meridians 330° and 5° of Schiaparelli's chart to the vicinity of the north polar ice-cap. The difference is very striking, especially in the region of Libya, between the first and second of this year, and the corresponding No. 3 for the year 1886.—On the explanation of an experiment by Joule according to the kinetic theory of gases, by M. Ladislas Natanson. The experiment in question occurs in vol. i. p. 183 of Joule's "Scientific Papers." From the considerations here advanced, M. Natanson concludes that, so far from being opposed to the kinetic theory of gases, this experiment might be regarded as a practical confirmation of the law determining the distribution of molecular velocities discovered by Clerk Maxwell, and generalized by Boltzmann.—M. Natanson's paper was accompanied by a note from M. G. A. Hirn, who still maintains that not one of his nine fundamental objections to the kinetic theory itself has yet been answered, and consequently that this theory is already out of date.—On the thermic conductivity of mercury above 100° C., by M. Alphonse Berget. In continuation of a previous note (*Comptes rendus*, April 16, 1888), the author here gives the results of his studies on the variation in the thermic conductivity of mercury between 100° and 300° C. For 1° he finds the variation in the coefficient of thermic conductivity to be -0.00045 .—Measurement of the velocities of etherification by means of electric conductibilities, by M. Negreano. The author has already shown that the velocity of etherification for a mixture with equal equivalents of alcohol and acetic acid may be measured by determining the electric resistance of the liquid by Lippmann's electrometric method. In the present communication he extends the same process to masses of alcoholic reagents or acetic acid differing in the number of their equivalents.—Observations respecting some recent communications from M. Sabatier on the chlorhydrate of cupric chloride, and the chlorhydrate of cobalt chloride, by M. Engel. While insisting on his admitted claim to priority, the author points out that there are two distinct chlorhydrates of the chloride of copper. He also shows that the pale blue powdery precipitate observed by M. Sabatier is not a chlorhydrate of chloride, but a hydrate of cobalt chloride.—On the elementary composition of crystallized strophanthine, by M. Arnaud. This is an extract from *Strophanthus Kombé*, much used by the Fans of West Equatorial Africa for poisoning their spear- and arrow-heads. The formula is here shown to be $C_{31}H_{48}O_{12}$, its elementary composition thus showing it to be a close homologue of the wabain ($C_{30}H_{46}O_{12}$), the active principle of the wabaio plant used for similar purposes by the Somali people.—Influence of the temperature of fermentation on the production of the higher alcohols, by M. L. Lindet. The experiments here described seem to show that the yield of the higher alcohols is little affected by varying the temperatures of fermentation.—On *Fascicularia radicans*, C. Vig., a new type of Anthozoa, by M. Viguier. This little specimen of an Alcyonium was lately obtained during some dredgings in the port of Algiers. From the description here given it appears to be most closely related to the Paraclyonia, although sufficiently distinct to form an independent group or sub-family of the Fasciculariæ.—M. A. d'Arsonval describes and illustrates a new metal self-regulating stove, which is intended to maintain invariable temperatures by the exclusive use of gas and water. It is specially adapted for physiological and microbiological researches, and is constructed essentially on the same principle as that submitted to the Academy on March 5, 1877.

BERLIN.

Physical Society June 29.—Prof. von Helmholtz, President, in the chair.—Dr. R. von Helmholtz exhibited a new form of bolometer differing from that used by Langley. In Langley's instrument the alterations of electrical resistance produced by radiation are measured by introducing the exposed bolometer into one arm of a Wheatstone bridge a similar one protected from the light being introduced into the second arm of the bridge, while the other two arms contain a corresponding resistance. In the new bolometer as constructed by Siemens and Halske all four arms of the bridge are composed of equal wires rolled up into a coil and of these coils 1 and 3 are illuminated, while 2 and 4 are kept dark, and then coils 2 and 4 are illuminated, and 1 and 3 kept dark. By this means a four-

fold sensitiveness of the bolometer is theoretically obtained. All four coils lie inside a brass tube, and by turning a screw at one time coils 1 and 3, at another coils 2 and 4 are brought opposite the opening. In comparing the speaker's experiments with those of Langley it appeared that the latter's measurements were five times more delicate than those of the speaker, a result which must however be entirely attributed to the fact that Langley's galvanometer was twenty times more sensitive. The speaker then expounded the theoretical efficiency and conditions of perfect sensitiveness of the bolometer, and compared with these the capabilities of a thermopile. Dr. Fritz Kötter discussed some new instances for the application of the Helmholtz-Kirchoff theory of stationary motion of fluids. Prof. Gad gave some explanations in connection with his demonstration of the phosphorescent moss. Prof. Neesen spoke on an ether calorimeter which he has succeeded in constructing in such a form, after many experiments, that it presents many advantages, when compared with an ice-calorimeter. It consists of a tube for the reception of the object whose heat is to be measured; this tube is surrounded with a layer of lamp-wick which dips into ether at its lower end. From the side of the outer vessel a tube passes with appropriate bending to a horizontal capillary tube containing as index some ether, and by a parallel capillary tube to a second and similar calorimeter. After the index has been adjusted, its movement, as resulting from the vaporisation of ether due to the warm object, indicates how much heat has been given up to the wick saturated with ether. The sensitiveness of this calorimeter is 2000 greater than that of an ice-calorimeter. The speaker has determined with this instrument the specific heat of platinum, palladium and copper, and also the heat produced by the passage of an electric spark between a metallic point and a mass of mercury in the tube of the calorimeter. The results were very satisfactory. The special advantage of this instrument consists in the fact that extremely small masses of any substance can be examined calorimetrically. The extreme sensitiveness of the apparatus makes it also suitable for the measurement of radiant heat. The speaker has additionally examined other fluids as to their suitability for a vapour-calorimeter, especially alcohol.

Physiological Society, July 6.—Prof. Munk, President, in the chair.—Prof. Zuntz described a simplified method of measuring the gaseous interchange during respiration, intended to make it possible to introduce such measurements into the limits of clinical observations to the same extent that urinary analysis is now carried out. In this method breathing is carried on, the nose being closed, through a mouth-piece which is connected by very mobile valves with gasometers, which thus measure the volume of the inspired as well as of the expired air. Samples of the expired air can be collected at any desired intervals of time and the amount of O and CO₂ which they contain determined by Hempel's method. The burette into which the gas is drawn off by means of an aspirating apparatus connected with the gas meter, is connected by a gutta-percha pipe with a vertical tube which is partly filled with water: the latter not only permits of the measurement, at atmospheric pressure, of the volume of air drawn off, but also provides a means of forcing it out of the burette into a pipette filled with a solution of caustic potash, in which the absorption of the CO₂ speedily takes place. By lowering the tube the gas is allowed to pass into the burette again, and the reduction in its volume gives the amount of CO₂ in the expired air. After this the gas is forced into a pipette which contains lumps of phosphorus which absorb all the oxygen it contains in five or six minutes. On passing the gas again back into the burette, the further diminution in its volume gives the amount of O in the expired air. A new sample can now be taken, and thus the expired air may be tested as often as may be desired for its contents of O and CO₂. Dr. Loewy has carried out some experiments with the above apparatus on five intelligent persons in order to determine the influence of digesting activity on the respiratory interchange. The respiratory interchange of the patients was determined in the morning while fasting and in a perfectly quiescent condition; as soon as this was found to be constant they received doses of 5, 10 or 15 grains of Glaubersalt, and as soon as the action of the salt had manifested itself painfully, and increased peristaltic action had set in, the respiratory interchange was again determined up to the time of defæcation. In all cases the gaseous interchange was increased, more oxygen being used up and more carbonic acid given out, the increase being between 7 and 30

per cent. of the normal. The several persons behaved very differently in this respect and the same person showed marked differences in the increase of respiratory interchange at different times, after equal doses of the salt. As a rule the increase was proportional to the amount of discomfort experienced by the patient in the lower parts of the body. Dr. Loewy is inclined to attribute the increased oxydational interchange to the greater activity of the unstriated muscles of the alimentary canal; the increased activity of its mucous membrane, resulting from the presence of the purgative, appeared to have no influence.—Prof. Munk gave an account of his experience last year while using catgut as a ligature. After having used catgut for some time as a substitute for silk, with excellent results, suddenly bad results began to follow its use, so that each ligature was accompanied by suppuration. A series of control experiments showed that the wounds healed well when silk was used, but never did so with catgut, and inasmuch as the above change was first observed after obtaining the catgut from a new source he proceeded to obtain the article again from the original source, and at once found it worked successfully again. No matter how long the second sample of catgut was disinfected its use was always attended with suppuration. Prof. Munk has hence reverted to the use of silk ligatures, and urges great caution in the use of catgut in surgery.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Parish Patches: A. N. Simpson (Buncle, Arbroath).—The Senses and the Will: W. Preyer, translated by H. W. Brown (Whittaker).—A New Theory of Necessary Truths: Leonard Hall (Williams and Norgate).—Camping Out, or Holidays under Canvas: Gyp; second edition (Simpkin).—A Bibliography of Chemistry for the year 1887: H. C. Bolton (Washington).—Bericht über die Thätigkeit der Botanischen Section der Schlesischen Gesellschaft im Jahre 1887: Dr. F. Cohn.—On the Structure, Development, and Affinities of *Trapella*, Oliv., a New Genus of Pedaliniæ: F. W. Oliver.—Bulletins of the Philosophical Society of Washington, vols. ix. x. (Washington).—Proceedings of the American Philosophical Society, vol. xxv. No. 127 (Philadelphia).—Botanische Jahrbücher für Systematik, Pflanzengeschichte, und Pflanzengeographie, Zehnter Band, 1 and 2 Heft (Leipzig).

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